PV DESIGN WORKSHEET *WITH OPTIMIZERS*
Based on the 2013 CEC

PROJECT ADDDRESS: _____ PLAN CHECK# _____

Breaker maximum sizes: #14 – 15A, #12 – 20A, #10 – 30A, #8 – 50A, #6 – 60A, #4 – 80A

**** the maximum number of optimizers in a string shall not exceed 19 unless the designer provides the technical data to show otherwise*****

Voc _____   Isc _____

Max. Inverter **Input** Voltage for 240 V system: _____Volts   (see inverter specs.)

Max. Inverter **input** current for 240 V system:_____Amps   (see inverter specs.)

Table 310.15 (see Article 110.14C)

1. **MAX PV VOLTAGE AND CURRENT CALCULATIONS:**

Wire Size	Max Ampacity
14	25
12	**30**
10	**40**
8	**55**
6	**75**

a.   Max PV system voltage (per NEC. 690.7):

Max. PV system voltage = Max. inverter input voltage=_____V

!!! Sec. 690.7C requires the Max PV voltage to be
Less than 600 volts

b.   Max PV current (NEC 690.8)

Max. PV current = Max. output current rating for optimizers which cannot exceed the inverter input current rating = _____A (exception: see footnotes for inverter. Some inverters limit input current even if the output current for the optimizers are greater)

2. **DC CONDUCTOR AMPACITY CALCULATIONS:** *(array to combiner box)* **NEC310.16**
    a. Expected wire temp. = _____ (41 deg. C or 105 deg. F. from table 310.15 (B) (2) (a)) ***See Rule K**
    b. Temp. correction = .58 (refer to table 310.15 (B) (2) (a)).
    c. # of current carrying conductors = _____
    d. Conduit fill de-rating: .80 (for more than 3 conductors per table 310.15(B)(3)(a)) If 3 or less: use "1"
    e. Circuit conductor size: _____ awg
    f. Circuit conductor ampacity (310.15(B)(16)): _____amps
    g. Required Circuit conductor ampacity.
            Max. **output** of optimizer current = _____amps **(see 1 b above)**
    h. De-rated ampacity of circuit conductor per CEC 310.15 (B) (2) (a)
            Temp. corr. (refer to table 310.15 (B) (2) (a)). **x** conduit fill corr. (per table 310.15(B)(3)(a)) **x**
            circuit conductor ampacity (CEC 310.15 (B) (16) = _____amps
            .58 x _____ x _____ = _____amps

    Note: H must be larger than G   Yes_____ No _____ (check one)

3. DC CONDUCTOR AMPACITY CALCULATIONS *(from combiner box OR JUNCTION BOX to inverter)*

    a. Ambient temp. adjustment, expose conduit (CEC 310.15 (B) (C) (3) + 22 degrees ***See Rule K**

        Expected wire temp. (C deg.) (CEC table 310.15 (B) (3) (c)): 41 deg. + 22 deg. = 63 deg.

        Temp. correction per table 310.15 (B) (2) (a): .58

        # or current carrying conductors: _____

        Conduit fill correction (NEC 310.15 B 3 a) _____.80 (for more than 3 conductors per table 310.15(B)(2)(a)) If 3 or less: use "1"

        Circuit conductor size: _____ ____ awg

        Circuit conductor ampacity: _____ amps

    b. Required circuit conductor ampacity

      Max. inverter **input** current = _____amps.

    c. Derated ampacity of circuit conductor (NEC 310.15 B 2 (a))

        Temp. correction (NEC table 310.15 B 2 (a)) x conduit fill correction (NEC 310.15B.3.a) x circuit conductor ampacity = _____amps

        .87 x _____ x _____ = _____amps

Note: *C must be larger than B   Yes____   No ____   (check one)*

4. AC CONDUCTOR AMPACITY CALCULATION: *(between inverter and main elect. Panel)*

    A.

    Expected wire temp. (deg. C) = 41 deg. (310.15 B 2 a)   *** See Rule K**

    Temp. correction (NEC 310.15 B 2 a) = .87 (no rooftop adjustment if AC conductors are not of roof)

    Circuit conductor size= _____awg

    # of current carrying conductors = _____

    Conduit fill (NEC 310.15 B.3.a = _____.80 (for more than 3 conductors per table 310.15(B)(3)(a)) If 3 or less: use "1"

    Circuit conductor ampacity = _____amps

    Inverter Model # _____

    Inverter maximum AC **Output** (for 240 V) _____A

    B. (calculation B)

    Required conductor ampacity (NEC 690.8B):

        Max. inverter **output** current = _____amps

    C.

    Derated ampacity of circuit conductors (CEC table 310.15 (B) (2) (a)):

    Temp. corr. (CEC 310.15 (B) (2) (a)) x conduit fill corr. (per table 310.15(B)(3)(a) x

Circuit conductor ampacity (table 310.15 (B) (16)=

.87 x _____ x _____ = _____ amps

Note: C must be larger B   Yes ____   No_ ___   (check one)

RULES:

A. **AC BREAKER: to be no more than the next standard breaker size up from (calculation 4B).**

B.   **Bus Rating: Article 705.12D(2) states that the sum of the ampere ratings of the overcurrent devices n circuits supplying power to a busbar or conductor shall not exceed 120% of the rating of the busbar or conductor.**

C. **AMPACITY CALCULATION FOR DC CONDUCTORS EXITING OPTIMIZERS - Module Wattage x # of otimizers shall me less than or equal to 5,200 Watts (max wattage rating for a standard solar edge converter). Example: To calculate the amperage the string, 5,200 W / 350 V = 14.9 A. So, size these conductors and derate for temperature so they do not exceed 14.9 A.**

D. **Maximum of 18 inches can cantilever beyond the standoff connection**

E. **AC BREAKER: to be rated to protect the conductor per table 310.16 and Art 240.4.D/240.6.A-**

F. **CONDUIT(S) SHALL BE PAINTED TO MATCH SURFACE AND SHALL BE INSTALLED MORE THAN ½"(INCHES) ABOVE ROOF SURFACE**

G.   **ALL EQUIPMENT TO BE LISTED FOR THE PURPOSE.**

H. **Provide SOLAR PANEL COPPER LAY-IN GROUNDING LUG, TIN PLATED, 14-4, STAINLESS STEEL SCREW, SUITABLE FOR DIRECT BURIAL**

I. **Use #8 bond wire from Service panel to rooftop, then #6 on rooftop where exposed. (NEC 250.120).**

J.   **Prior to the installation of the solar panels, the Contractor shall schedule an anchorage inspection for all standoffs.**

K. **The ASHRAE (90.1) 2% Temperature should be used for all starting ambient temperatures. This is the temperature that is likely exceeded during 14 hours (not necessarily continuous) over a summer month (June through August). The rooftop temperatures for conduit are then adjusted for rooftop conditions. For example in Ontario the 2% temperature is 37°C or 98.6°F. NEC table 310.15(B)(3)(c) then shows us we need to add 22°C or 40°F to conduit that is placed ½" to 3-1/2" above the roof surface. The rooftop temperature measurement then becomes 59°C or 138.2°F.**

L. **SMOKE DETECTORS SHALL BE INSTALLED:**

  a- **Centrally located in corridor (or area) leading to sleeping areas, and inside each sleeping room.**

  b   **On ceiling of upper level in close proximity to the stairway when sleeping areas are on an upper level.**

  c   **On each floor level and in basement.**

  d   **In the adjacent room (or area) where the ceiling height exceeds that of the hallway by 24" or more.**

  e   **Battery operated smoke detector permitted in existing construction.**

  CARBON MONOXIDE SHALL BE INSTALLED:

  a.   **Outside of each separate dwelling unit sleeping area in the immediate vicinity of the bedroom(s).**

  b.   **On every level of a dwelling unit including basements.**

       c.   **Battery operated carbon monoxide detector permitted in existing construction.**

Definitions:

Combiner box: **used where long runs of wire occur in order to reduce cost of installing many smaller wires.**

Junction box: **used to change type of wire from "roof cable" to THWN-2**

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